African Restoration Ecology (Environmental Science)

Methodological Evaluation of Smallholder Farm Systems in Ethiopia Using Multilevel Regression Analysis for System Reliability Assessment

Berhan Gebreab[1], **Mulu Wondimu**[1,2]

[1] Department of Interdisciplinary Studies, Africa Centers for Disease Control and Prevention (Africa CDC), Addis Ababa

[2] Ethiopian Public Health Institute (EPHI)

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Correspondence: bgebreab@gmail.com

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Author notes

Berhan Gebreab is affiliated with Department of Interdisciplinary Studies, Africa Centers for Disease Control and Prevention (Africa CDC), Addis Ababa and focuses on Environmental Science research in Africa.

Mulu Wondimu is affiliated with Department of Interdisciplinary Studies, Africa Centers for Disease Control and Prevention (Africa CDC), Addis Ababa and focuses on Environmental Science research in Africa.

Abstract

Smallholder farms in Ethiopia face significant variability in productivity due to climate fluctuations and limited resources. A multilevel regression model was applied to assess the impact of climate variability, soil quality, and farmer management practices at both individual and aggregated levels on farm productivity. The multilevel regression analysis revealed that soil organic matter content had a significant positive influence on crop yield ($\beta = 0.32$, $p < 0.05$), indicating its importance in enhancing system reliability. Multilevel regression analysis provided insights into the resilience of smallholder farm systems under varying environmental conditions. Investment in soil conservation and organic matter enhancement could improve the stability of Ethiopian smallholder farms, thereby increasing overall productivity. The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p\, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Ethiopia, Smallholder Farms, Multilevel Regression, System Reliability, Climate Variability, Stochastic Modelling, Resource Allocation*

ABSTRACT-ONLY PUBLICATION

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